Belt and Road: The China Dream?

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Abstract

This paper explores the impact of the Belt and Road Initiative (BRI), in terms of changes in trade costs on trade and consumer welfare in China, the EU, and the rest of the World. We employ a general equilibrium structural gravity approach and conduct a counterfactual analysis. Our key findings are as follows: (i) China and the EU are expected to make substantial gains from the BRI due to reductions in transport costs (ii) signing and implementing a deep FTA between China and the EU is equivalent to transport cost reductions of 15-20 percent (iii) the joint policy of the BRI and FTA is super-additive, magnifying the gains from the separate policies (iv) where transport cost reductions are 20 percent or more, the potential negative effect of the China-US trade war on China is more than compensated for by the BRI initiative. Our results provide evidence that the BRI has the potential to deliver significant welfare gains, particularly if combined with other trade integration schemes, and to counterbalance aggressive trade policies.

Keywords*:* Belt and Road Initiative, China, EU, Gravity model, trade

I. Introduction

All the routes which form the Chinese-led 'Belt and Road Initiative' (BRI)[1] lead to Europe. This policy is, centrally but not exclusively, aimed at lowering trade costs via a plethora of infrastructure development projects. The initiative has led to a sizeable body of literature that is largely descriptive in nature. However, partly because of the difficulties of pinning down the specifics of the policy environment, there is very little rigorous economic empirical work (for exceptions to this, see Herrero and Xu (2017) and the research starting to emerge from the World Bank, such as that of Baniya et al. (2019), De Soyres et al. (2018), De Soyres et al. (2020) and World Bank (2019)). In particular, De Soyres et al. (2018) report a decrease in shipping times resulting from the BRI and translate these into ad-valorem trade cost reductions. Our focus is on assessing the unexplored impact of the BRI on Chinese and EU welfare.

The BRI is not underpinned by an agreement outlining detailed rules, akin to what we would expect from trade agreements. This is a multi-layered policy whereby the Chinese central government originates the general policy, which is decentralised to ministries and local governments for the detail. The scale of China promotes this multi-layered approach but the negative side effect is that central government has difficulty harvesting the generated information to create a full policy brief. Inside China this method of policy development is well understood, hence the familiarity with slogans (e.g. 'China Dream') rather than detailed policy. However, the BRI pivots China towards the international stage. The countries it is trying to engage in this initiative are more accustomed to detailed policy documents. This is particularly the case for the European Union, which approves of well-established trade arrangements that bring welcome levels of detail and certainty regarding the rules of the game. But while the BRI continues to rapidly evolve, the China-EU Comprehensive Investment Agreement (linked to a China-EU Free Trade Agreement, FTA) has only just been agreed in principle after more than six years of negotiations.

It is also important to understand how the BRI interplays with current China-US trade tensions, since the trade war is an important and topical benchmark against which BRI gains can be measured. The US has been concerned with China's rising economic and political assertiveness for some time. The Obama administration took the tack of pursuing a co-operative international policy, engaging with trading partners through so-called mega-deals – the Transatlantic Trade and Investment Partnership (TTIP) and Trans-Pacific Partnership (TPP). The Trump administration, on the other hand, engaged in a

[1] Also known as 'One Belt One Road' (OBOR).

policy of confrontation with its trading partners by threatening them with escalating import tariffs. Between Jan 2018 and Jan 2020, the US increased the average tariff on Chinese imports from 3 to 21 percent, while China increased average tariffs on US products from 8 percent to 20.9 percent during the same period (Peterson Institute for International Economics). The recent (phase one) US-China agreement promises very little in terms of reducing these tariffs.

The Chinese commitment to the BRI makes it critical for academics to engage with assessing this policy, despite its Chinese characteristics (in this case, opaqueness). The current literature lacks empirical analysis of the impact of the BRI on Chinese and EU welfare. Moreover, the quantification of these impacts is more meaningful if benchmarked against other trade policy changes. Therefore, this paper provides an important contribution to the limited existing literature by using a multi-country general equilibrium structural gravity model to explore the impact of the BRI on China and the EU benchmarked against the US-China trade war. We also simulate the impact of a China-EU FTA as well as the combined effect of the FTA alongside the BRI. While our main results consider a deep China-EU FTA, for robustness we explore different types of trade agreements. Therefore, the simulations conducted in this paper provide an important illustration of the potential trade-offs facing policy makers.[2]

The BRI aims to reduce non-tariff barriers (NTBs) and transportation costs via infrastructure investment along six corridors. Therefore, the focus of this paper is to model changes to trade costs on welfare. Moreover, our framework permits us to model the effect of BRI-related policy decisions on economic welfare through the plurilateral reduction in trade costs, isolating them from the impact of changes in productivity, labor mobility, and capital market integration. In short, we construct a tractable model of global trade without compromising its general equilibrium features.

Our empirical strategy is based on the general equilibrium structural gravity analysis developed by Anderson et al. (2015, 2018)[3], in that we compute the price effects of changes in trade costs and FTA formation associated with different policy scenarios, based on the general equilibrium global trade flows, using 2014 data as a benchmark (for a similar approach see also Jackson and Shepotylo, 2018). The relative merits of each scenario are examined from the standpoint of the welfare gains/losses of a representative consumer.

[2] General equilibrium structural gravity analysis tends to involve less parameters than Computational General Equilibrium (CGE) analysis, where the gravity parameters are estimated structurally, and the structure of the economy is implicitly accounted for. The larger CGE models will account for a more complex array of dimensions but this also means that it can be difficult to understand the impact of trade policy changes.

[3] See also Anderson et al. (2019).

We compute welfare gains for the conditional and full general equilibrium (GE). The former calculates welfare changes keeping output and expenditure constant, while the latter also accounts for the changes in output and expenditures due to global price adjustments.

We find that a reduction in transport costs between China and the EU would lead to considerable welfare gains for both parties. For example, a 10 percent reduction in transport costs would increase the welfare of a representative consumer in China by 1.57 percent and in the EU by 0.49 percent for the full GE model. On the other hand, signing a deep FTA between China and the EU would increase welfare by 2.52 and 1.25 percent respectively. Further, a joint policy of reducing transport costs (via the BRI) and signing the (deep) FTA would increase welfare by 4.26 and 1.79 percent; this is larger than the sum of the gains from the two separate policies. Therefore, the joint policy is super-additive, magnifying the gains from the separate policies.

The positive effect of the BRI on China from trade cost reductions of 20 percent is more than compensatory for the potential negative effects of a trade war with the US (assuming 25 percent tariffs). There is an overall increase in global welfare from the BRI and the welfare gains under the conditional and full GE are positive across the board. The results are robust to different assumptions about the structure of trade cost reductions and accounting for the heterogeneous effects of regional trade agreements. Using the World Bank estimates of trade cost reductions predicts lower welfare gains for China, but higher welfare gains for some low and lower middle-income countries, especially located in Central and South Asia and Africa. Our analysis of the heterogeneous RTA effects shows that for a China–EU FTA to have a strong positive effect, it should go beyond small tariff reductions.

The rest of this paper is organized as follows. Section II examines the background to the scenarios used in the model, followed by a discussion of the model in Section III. Methodology and data are discussed in Section IV. Section V outlines the empirical results, while Section VI discusses the results of the welfare analysis. Section VII performs robustness checks, while section VIII concludes.

II. Developing the scenarios

Belt and Road Initiative

The BRI consists of two strands: The Silk Road Economic Belt (the ‘Belt’) and the 21st Century Maritime Silk Road (the ‘Road’). Between them, they stretch across South-East Asia, Eastern Europe, and Africa with the aim of connecting Europe and Asia[4]. The countries involved include around half the population of the world (Appendix A)[5]. An important pillar of the BRI is its investment in infrastructure along its six corridors, with the objective of lowering transport costs (Huang, 2016; Du and Zhang, 2018). ‘The New Eurasian Land Bridge’ focuses on multiple rail links between China and Europe, where potential cost reductions may arise from reducing the number of border checks and addressing any issues regarding break-of-gauge. These faster routes have significant potential advantages for producers willing to pay a premium for higher speed freight. ‘The China – Mongolia – Russia Corridor’ covers rail and road links with potential reductions in clearance times as well as faster international road freight routes that replace rail links. There are considerable potential benefits for the more remote areas of Mongolia and Russia that will, as a result, be connected to key markets. ‘The China – Central Asia – West Asia Corridor’ covers Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan, Turkey, and Iran; here the focus is on energy trade, including gas and oil pipelines. This route provides a faster rail alternative to the sea route that departs from Shanghai port. ‘The China – Indochina Peninsula Corridor’ primarily covers rail, road, and air links that better connect the Association of Southeast Asian Nations (ASEAN) with China. However, progressing the work along this corridor has been problematic, with ticklish political relations and a degree of instability in some of the countries involved (e.g. Thailand and Malaysia). On the other hand, ‘The Bangladesh – China – India – Myanmar Corridor’ has a broader multi-mode agenda that includes development in transport, investment, and people. However, many challenges exist with this route, including the practical difficulties engendered by the variety of different gauges used by the Bangladeshi and Indian railroads and the generally poor state of Bangladesh’s railway infrastructure. Finally, ‘The China – Pakistan Corridor’ refers to highways, railways, energy pipelines, and digital infrastructure. This corridor is important in terms of enabling trade to avoid the Strait of Malacca (discussed in more detail later in this section), but this requires completing projects in inclement terrain while also facing opposition from India. In summary, each corridor is the subject of separate discussions/negotiations, making the BRI a complex set of arrangements.

China-EU Trade and Investment

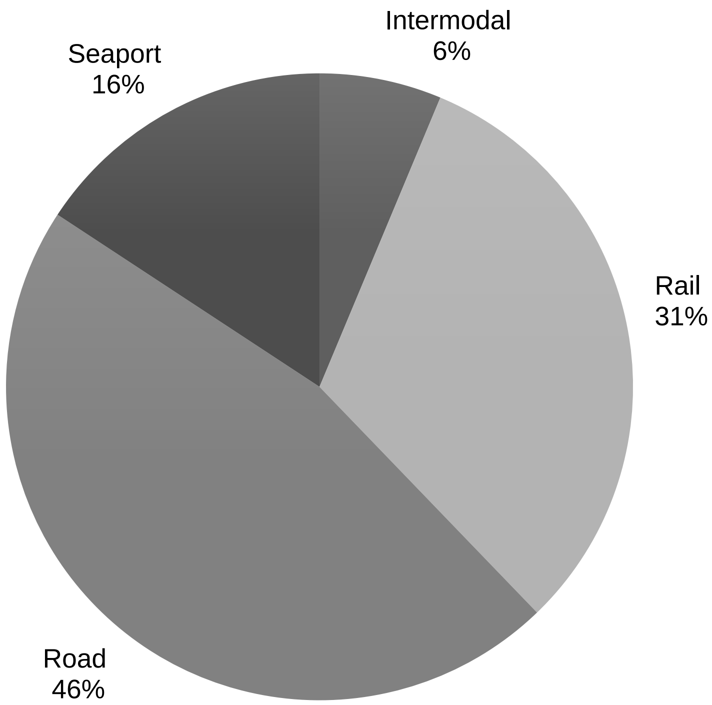
[4] The first edition of the policy was published in 2015: http://en.ndrc.gov.cn/newsrelease/201503/t20150330_669367.html and the Communist Party Charter was amended to include the BRI during the closing session of the 19th Communist Party of China National Congress (24 Oct 2017). For a detailed discussion on the ‘Go West Program’ see Lin and Chen (2004)
[5] In addition, the EU member states are incorporated into our core group.

While all BRI trade routes end in Europe, Europeans remain deeply divided on the issue of the BRI. There is little appetite for turning away investment but there is an identified need for the strategic oversight and planning of inward and outward investment, which underpins market access. The absence of large-scale state ownership across Europe limits the tools available. One approach to tackling this issue is in the form of the EU-China Comprehensive Agreement on Investment, with the potential of a China-EU FTA to follow. Skeptical observers may note that while the EU has been attempting to broker a deal that provides EU companies with the opportunity of more easily making investments in China, substantial Chinese investment has already been taking place in the EU via Bilateral Investment Treaties (BITs) with individual member states. These largely outdated agreements do not grant the EU equivalent access to the Chinese market.

The projects

One of the difficulties in assessing the impact of the BRI is the lack of credible information on the individual projects. To the best of our knowledge, the Reconnecting Asia Project at the Centre for Strategic and International Studies provides the most comprehensive database of infrastructure projects linked to the BRI. However, it is likely there will be projects omitted from the database due to issues around data collection and processing. Figure 1 provides an overview of the BRI projects extracted from the database, which shows the proportion of BRI projects by infrastructure type based on the number of projects in each category. Road projects are the most popular. Appendix B provides four maps that illustrate the countries that have planned projects and the mode of transport. This provides a visualization of the development of the six corridors. Delving a little deeper into the number of projects by country, we find considerable heterogeneity in the cost, number, and type of projects across countries. For example, Pakistan has the largest number of individually recorded projects but the total cost of these projects ranks as only the fourth highest after China, Belarus, and Russia. Russia, on the other hand, has one major project: the Moscow-Kazan High Speed Railway.

Figure 1: Number of BRI projects by infrastructure type



Source: Based on the Reconnecting Asia Project at the Centre for Strategic and International Studies

The Moscow-Kazan High Speed Railway development project is recognised as part of both the BRI and the Moscow-Beijing Railway Initiative, which had stalled when relations with Europe worsened and the Russian economy lacked the resources to support such an ambitious project, currently costed at $21 billion. If brought to fruition, this project will lead to the first high speed bullet trains operating in Russia to transport people and cargo. It is part of a bigger agenda to link first Beijing and Moscow, and then Europe and China. The equipment is expected to be manufactured by Chinese companies, with Chinese expertise derived from the rail infrastructure projects in the cold climate covered by the Harbin-Dalian high-speed railway. This is an illustrative example of an expensive project offering the potential for significant transport cost reductions. If finalised, this could be the first rail line in Russia to reach speeds of 400 km/hr - at present there is nothing over 200 km/hr operating in the country.

Infrastructure projects and transport cost reductions

The translation of these projects into reductions in transport costs is central to the BRI. The projects are expected to bring down transport costs by improving existing transport routes and opening new ones. Planned improvements include reforms to customs procedures and border management. We may therefore see traders either using the same routes but at a lower cost or switching to lower cost alternatives. Switching would include the possibility of changing the mode of transport, such as moving from sea-routes to rail-routes. In the context of China-EU trade routes, there is a heavy reliance on the Strait of Malacca, which is both a bottleneck and a piracy target. This sea-route is also part of a well-known territorial dispute. So aside from the fact that sea freight is relatively slow (but currently the most cost effective), there are additional reasons for Chinese policy makers to develop alternative land routes, including the Beijing-Moscow rail project mentioned above[6]. Indeed, our illustrated overview of the BRI planned projects show considerable investment into rail-infrastructure, despite the high costs of these types of projects.

There is some interesting research in the existing literature that explores investment into rail infrastructure. This drives our explanation of the potential transport cost reductions across rail-routes that also provide an opportunity for mode switching. This discussion attempts to unpack the reasons for infrastructure development projects that may lead to transport cost reductions; we reflect this in our empirical approach by the inclusion of a transport infrastructure parameter in our model.

Historical evidence suggests that the potential effects of transport infrastructure investments on welfare are substantial. For example, the development of the railroads in India in 1870-1930 lifted income by 16 percent, only half of which can be directly attributed to transport cost reductions (Donaldson, 2010). Assumptions on the magnitude of transport cost reductions due to BRI investments in infrastructure is one of the key unknowns that needs to be pinned down. While BRI investment plans are still developing, prior literature gives us important insights for making plausible estimates. Findlay and O'Rourke (2009, Table 7.2) conclude that with the development of railroads in the 2nd half of the XIXth century, the freight cost of shipping wheat from Chicago to the UK dropped by 25 percentage points. Mohammed and Williamson (2004) estimate that during 1870-1910 real freight rates declined by almost 50 percent. More recently, cross-sectional data on transport and telecom infrastructure shows that improvements in the infrastructure from the 25th to 75th centile reduce transport costs by 24 percent (Limao and Venables, 2001). The literature also gives us evidence on recent improvements in the railroad infrastructure between China and Europe, and on the consequent reduction in transportation costs. In 2011-2015, 9 new railroad routes were opened between China and Europe (Li

[6] Wen et al. (2019) discuss the low mode reliability of sea routes, although sea-freight is currently the least expensive. Furthermore, the authors provide estimates of the average speeds of China-Hamburg freight trains (the highest at 37 km/hr) thus providing a useful benchmark for the proposed new high-speed line in Russia (400 km/hr).

et al., 2018). The new railroad, connecting Chongqing to Duisburg, takes 20 days less than sea shipping (in part due to the highly efficient customs clearance) and it is 80 percent less expensive than air transportation.[7] Given that 95 percent of all shipments are currently made by sea, there are considerable gains to be made by improving railroad transportation links with Europe. This would provide a relatively cheap and highly reliable mode of transportation for moving perishable goods and on-demand production goods, as well as developing more integrated supply chains across the Eurasian continent.

It is important to highlight the estimates of transport cost reductions due to the BRI that have been provided by De Soyres et al. (2018). The authors transform estimates of changes to shipping times into ad-valorem trade cost reductions, which range from 1.5 - 2.9 percent in BRI countries if mode switching is not permitted and there are no improvements in customs procedures. However, their estimates are much higher when they allow for mode switching and customs improvements; the largest reductions of 25.5 percent are found for the China - Central Asia – West Asia Corridor. However, De Soyres et al.'s research is limited to rail and sea routes. The Reconnecting Asia Project database, on the other hand, also includes road, bridge and tunnel projects. This broader range of projects is likely to increase the trade cost reductions beyond those found in De Soyres et al. Therefore, the effects of transport infrastructure investments on trade and welfare are substantial. In what follows, we model transport cost reductions as a range between 5 and 20 percent as well as using the trade cost reductions estimated by De Soyres et al. (2018).

The scenarios

Table 1: Counterfactual scenarios

	Scenario	**Description**
1	BRI	Reduction in transport costs associated with BRI infrastructure projects: 5-20% and estimates by De Soyres et al., 2018.
2	EU FTA	China-EU deep FTA
3	BRI & EU FTA	BRI and China-EU deep FTA
4	Trade war	Change in US-China tariffs by 10-40%
5	BRI & Trade war	BRI and Trade war

The basis for our first scenario in Table 1 is transport cost reductions, which are derived from the infrastructure projects and improvements in customs procedures. While transport cost reductions

[7] According to Djankov et al. (2010), each day of delay reduces bilateral trade by approximately 1 percent.

are only one aspect of the BRI, this will be the element modelled within this scenario. Our earlier discussion in this section explained the rationale behind our approach of accounting for the complexity and uncertainty of the arrangements by considering the estimates from De Soyres et al. (2018) as well as a range of uniform transport cost reductions between China, BRI countries, and the EU and then estimating the associated welfare impacts. This scenario is reflected in our empirical approach by the inclusion of a transport infrastructure parameter (λ_{ij}) in our model.

Scenarios 2-5 have been constructed to shed light on a number of important issues that shape the current trading environment (the US-China trade war) or may complement the BRI (a China-EU FTA). Scenario 2 considers the impact of a deep and comprehensive FTA between China and the EU, with tariff and non-tariff barriers to trade eliminated and a reduction in trade policy uncertainty resulting from the commitment of both sides to free trade. The potential impact of a China-EU FTA is based on the average impact of preferential trade agreements over more than 50 years. We conduct a sensitivity analysis by looking at a range of average impacts of FTAs, estimated by alternative methods and model specifications.

We model the China-US trade war as an across-the-board reciprocal increase in applied bilateral tariffs. It is important to understand how the trade war would interplay with the BRI to shape our understanding of the future of global trade, estimate its welfare implications, and formulate potential policy responses. Furthermore, the uncertainty regarding the future of the China-US trade relationship leads us to consider the impact of the US-China trade war based on a range of tariff increases from 10 to 40 percent. Therefore, the trade war scenarios are not representing the current state of play but the potential escalation or reduction of tension through higher/lower tariffs. We assume that the tariffs are reciprocal since the latest data from the Peterson Institute for International Economics suggests that the average tariffs were almost identical by 17th Sep 2019: 21.1% for China’s average tariff on US exports and 21% for the US average tariff on Chinese exports; only small adjustments were made thereafter.

Finally, it is important to acknowledge that we are not accounting for the investments paid out by China or other BRI countries. The difficulties in obtaining this information is discussed in De Soyres et al. (2020). It is also worth noting that these authors assume zero investment costs for EU countries. We leave this as an area for future research and confine ourselves to scenarios 1-5 while acknowledging that the costs of investments necessary to build the infrastructure may significantly erode the welfare gains for some BRI countries.

III. Model

We employ a structural gravity approach to measure the welfare gains of the BRI policy on China, the EU, and the rest of the World. This approach is consistent with a wide class of trade models, including Armington (Armington, 1969), monopolistic competition (Krugman, 1980), heterogeneous firms under monopolistic competition (Melitz, 2003), and heterogeneous firms under perfect competition (Bernard, Eaton, Jensen, & Kortum, 2003) models. Our theoretical model is based on Armington assumptions but can be modified to fit the other models. To compute welfare changes, the structural gravity only requires 1) current allocations of factors, production, and trade flows and 2) an estimate of the trade elasticity parameter. This model has been used to estimate the effect of the North Atlantic FTA (NAFTA) (Anderson et al. 2015), TTIP (Felbermayr et al., 2015), and Brexit (Jackson and Shepotylo, 2018).

Setup of the model

Consider a world economy consisting of N countries, indexed by $i = 1 \ldots N$. Given an existing stock of capital K_i, inelastically supplied labor L_i, and productivity A_i, each country produces a unique variety i according to the following production function

$$Q_i = A_i K_i^{\alpha_K} L_i^{\alpha_L} \qquad (1)$$

There is a representative consumer in country j with constant elasticity of substitution (CES) utility defined as

$$C_j = \left(\sum_i C_{ij}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \qquad (2)$$

where C_{ij} is consumption of variety i and $\sigma > 1$ is elasticity of substitution across varieties. The consumer maximizes (2) subject to a budget constraint

$$\sum_i P_{ij} C_{ij} = E_j \qquad (3)$$

where P_{ij} is the price of the variety i in the country j and E_j is aggregate expenditure. Trade is costly – it takes $\tau_{ij} \geq 1$ units of good i to deliver one unit of this good from i to j, with $\tau_{ij} = 1$ only when $i = j$. We assume that the transportation sector is competitive, hence the price of good i in country j is given by $P_{ij} = \tau_{ij} p_i$, where p_i is a 'factory gate' price in i. We elaborate on trade costs in the next section.

Description of global equilibrium

Solving the model yields a structural gravity representation

$$X_{ij} = \frac{Y_i E_j}{Y_w}\left(\frac{\tau_{ij}}{\Omega_i P_j}\right)^{1-\sigma} \qquad (4)$$

where X_{ij} is export from country i to country j, $Y_i = \sum_j X_{ij}$ is total income in country i, and $E_j = \sum_i X_{ij}$ is total expenditure in country j. We further assume that current trade imbalances persist in the long run, such that $E_i = \mu_i Y_i, \forall\, i \in 1,2,\ldots, N$.

There are two crucial variables that capture all relevant information about how the world economy influences bilateral trade. These are outward multilateral resistance (ORT)

$$\Omega_i^{1-\sigma} = \sum_j \frac{E_j}{Y_w}\left(\frac{\tau_{ij}}{P_j}\right)^{1-\sigma} \qquad (5)$$

which aggregates the state of the global economy relative to the country i producer, and inward multilateral resistance (IRT)

$$P_j^{1-\sigma} = \sum_i \frac{Y_i}{Y_w}\left(\frac{\tau_{ij}}{\Omega_i}\right)^{1-\sigma} \qquad (6)$$

which summarizes configuration of prices and trade costs for country j consumers. A factory gate price in country i in equilibrium, denoted as lowercase p, is characterized as follows

$$p_i = \left(\frac{Y_i}{Y_W}\right)^{1/(1-\sigma)} \frac{1}{\Omega_i} \qquad (7)$$

Finally, combining definition of income with (7), the equilibrium income is given by

$$Y_i = p_i Q_i = Y_W^{1-\rho} \times \frac{1}{\Omega_i^{\rho}} \times Q_i^{\rho} \qquad (8)$$

where $\rho = (\sigma - 1)/\sigma$ is a parameter determined by the elasticity of substitution and Y_w is global income.

IV Structural estimation and data

Parametrization of trade costs and BRI

We parametrize trade costs as follows

$$\tau^{1-\sigma}_{ij} = \exp\left(\gamma_{dist}\ln\left(\lambda_{ij} \times dist_{ij}\right) + \gamma_{FTA}FTA_{ij} + Z_{ij}\gamma_Z\right) + u_{ij} \quad (9)$$

Trade costs increase with distance and are also influenced by the transport infrastructure parameter, λ_{ij}. In our simulations, we model improvements in transport infrastructure as a percentage reduction in λ. FTAs facilitate trade by lowering tariff and non-tariff barriers, reducing trade policy uncertainty, and giving countries more opportunities to develop long value chains and just-in-time production processes. In what follows, we model a free trade agreement between the EU and China and the China-US trade war as benchmark policy scenarios. In addition, China aims to simplify the process of moving goods along the Eurasian transport corridor, which would be isomorphic to signing a free trade agreement that reduces non-tariff barriers to trade. Other factors affecting trade costs, such as a common border, cultural proximity, language barriers, commonality of legal systems, and a colonial past, are all part of Z_{ij}. Finally, the error term u_{ij} is assumed to be uncorrelated with the above-mentioned variables.

Conditional general equilibrium welfare effects

We evaluate how changes in trade costs and trade policies, *ceteris paribus,* influence global equilibrium trade flows and welfare. For the conditional general equilibrium (Head and Mayer, 2014; Anderson et al., 2018), we keep production and expenditure constant and assume that a vector of trade costs changes due to an exogenous shock from τ to τ'.

Following Anderson et al. (2018), we evaluate inward and outward multilateral terms before and after the shock by applying the Poisson Pseudo Maximum Likelihood estimator (PPML) (see Silva and Tenreyro, 2006). Our estimated model is given by

$$X_{ij} = \exp\left(\gamma_{dist}\ln\left(\lambda_{ij} \times dist_{ij}\right) + \gamma_{FTA}FTA_{ij} + Z_{ij}\gamma_Z + \chi_i + \xi_j\right) + u_{ij} \quad (10)$$

At the second stage, we modify our policy variables to λ'_{ij} and FTA'_{ij} to reflect changes to the policy scenario and re-estimate the model. For the BRI scenario, we assume that BRI and EU countries experience trade cost reductions in their trade with China: $\lambda'_{ij} = c_{ij}\lambda_{ij}$, where $0 < c_{ij} < 1$ if $i = \text{China}$ and $j = \{\text{BRI or EU country}\}$, or $i = \{\text{BRI or EU country}\}$ and *j=China*. Otherwise, $c_{ij} = 1$. For the FTA scenario, we assume that the FTA value switches to 1 if *i=China* and *j={EU country},* or *i={EU country}* and *j=China*. We constrain the coefficients of policy and selection variables to be equal to our estimated coefficients from the previous stage.

$$X_{ij} = \exp\left(\hat{\gamma}_{dist}\ln(\lambda'_{ij} \times dist_{ij}) + \hat{\gamma}_{FTA}FTA'_{ij} + Z_{ij}\hat{\gamma}_Z + \chi'_i + \xi'_j\right) + u'_{ij} \qquad (11)$$

Using the result by Fally (2015)[8], and given the set of $\{\hat{\xi}_j\}$, $\{\hat{\chi}_i\}$, $\{\hat{\xi}'_j\}$, and $\{\hat{\chi}'_i\}$, estimated using PPML according to (10) and (11), we compute the inward and outward multilateral resistance terms according to the following expressions:

$$\hat{P}_j^{1-\sigma} = E_j \exp\left(-\hat{\xi}_j\right)/E_0 \qquad (12)$$

$$\hat{P}'^{1-\sigma}_j = E_j \exp\left(-\hat{\xi}'_j\right)/E_0 \qquad (13)$$

$$\hat{\Omega}_i^{1-\sigma} = E_0 Y_i \exp(-\hat{\chi}_i) \qquad (14)$$

$$\hat{\Omega}'^{1-\sigma}_i = E_0 Y_i \exp(-\hat{\chi}'_i) \qquad (15)$$

where E_0 is the level of expenditure in the country for which the inward multilateral resistance is normalized to $P_0 = 1$.[9]

Finally, we evaluate welfare changes, measured by changes in real income, according to the following formula,[10]

$$\hat{W} = 100\% \times \left(\frac{\hat{P}_i}{\hat{P}'_i} - 1\right) \qquad (16)$$

Full general equilibrium

We also compute the full general equilibrium (GE) effect of each scenario, following the algorithm suggested by Anderson et al. (2018). This accounts for adjustments in the prices of exports caused by changes in trade costs, which lead to further changes in income, expenditure, and trade. In particular, after performing the conditional general equilibrium computations, we update `factory gate' price according to the following formula

$$\frac{p'_i}{p_i} = \frac{\hat{\Omega}_i}{\hat{\Omega}'_i} = \left\{\frac{\exp(-\hat{\chi}_i)}{\exp(-\hat{\chi}'_i)}\right\}^{1/(1-\sigma)} \qquad (17)$$

We further compute new values of income, and expenditure, and bilateral trade flows respectively as follows

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[8] Fally (2015) has shown that when (10) is estimated by PPML, it automatically satisfies any structural gravity constraint on fitted production $\sum_j \hat{X}_{ij} = \sum_j X_{ij} = Y_i$ and fitted expenditures $\sum_i \hat{X}_{ij} = \sum_i X_{ij} = E_j$ for any i and j, because the PPML first order conditions are equivalent to the first order conditions of the model optimization. He also has shown that (12)- (15) are unique solutions for inward and outward multilateral resistance terms in the structural trade model (4)-(8).

[9] We chose New Zealand as the reference country.

[10] We follow the long tradition in trade literature, which measures changes in welfare as changes in real income. See for example, Arkolakis et al. (2012). Our model assumes that $E_i = \mu_i Y_i, \forall\, i \in 1,2,\ldots,N$. As a result, changes in real income translate one to one to the changes in real expenditures.

$$Y_i' = \frac{p_i'}{p_i} Y_i \qquad (18)$$

$$E_j' = \frac{p_j'}{p_j} E_j \qquad (19)$$

and

$$X'_{ij} = \frac{\tau'^{1-\sigma} Y_i' E_j' \widehat{\Omega_i^{1-\sigma}} \widehat{P_j^{1-\sigma}}}{\tau^{1-\sigma} Y_i E_j \widehat{\Omega_i'^{1-\sigma}} \widehat{P_j'^{1-\sigma}}} X_{ij} \qquad (20)$$

Finally, we solve for a new equilibrium following the same computational procedure as described in the conditional gravity section. This iteration process continues until `factory gate' prices converge to the full GE values. Welfare gains under full GE, measured by gains in real income, are computed as follows

$$\hat{W} = 100\% \times \left(\frac{Y_i' / \hat{P}_i'}{Y_i / \hat{P}_i} - 1 \right) \qquad (21)$$

Data

(i) Gravity estimation

Aggregate bilateral exports measured in billions of current US dollars are taken from the Direction of Trade Statistics (DOTS) provided by the International Monetary Fund (IMF).[11] Our DOTS sample covers 157 countries in 1960-2014. The data on Gross Domestic Product (GDP) in current US dollars and total population are from the World Development Indicators (WDI) published by the World Bank. FTA data are taken from the Centre D'Ètudes Prospectives et D'Informations Internationales Gravity dataset (CEPII, see Head et al., 2010 for a detailed description of the data). FTA is a binary variable that takes a value of 1 if a country-pair has an active FTA agreement in place and 0 otherwise.[12] Effectively Applied tariffs, which are available for 1988-2014, are taken from the UNCTAD Trade Analysis Information System (TRAINS) database. Geographical characteristics and distances between countries are also taken from CEPII. Colony and contiguity dummy variables are used to control for pair-specific trade costs that are not directly related to distance. Furthermore, the dummy variable representing common legal origin captures the compatibility of the legal systems of trading partners, as well as the trade costs related to the signing of contracts. The common spoken language and common religion dummy variables capture the

[11] We have chosen DOTS over alternative data sources such as COMTRADE or WIOD because DOTS has a longer time dimension than COMTRADE and covers more countries than WIOD.
[12] We also classify custom unions as free trade agreements.

effects of cultural similarities on trade (Melitz and Toubal, 2014). Table 2 reports summary statistics for variables used in the gravity analysis for the panel in 1960-2014 with 5-year intervals (4 years for the last year of observations) and for a cross-section in 2014.

Table 2: Summary statistics

Variable	**N**	**Mean**	**St. Dev.**	**Min**	**Max**
			Panel A: 1960-2014 sample		
Exp>0, Yes=1	234,570	0.536	0.499	0	1
Export, bln USD	125,544	2.388	92.761	0	15319
Ln(1+Applied tariff/100)	70,497	0.098	0.082	0	2.206
FTA, Yes=1	234,570	0.072	0.258	0	1
Common border, Yes=1	234,570	0.026	0.160	0	1
External trade, Yes=1	234,570	0.993	0.083	0	1
Colonial past, Yes=1	234,570	0.014	0.119	0	1
Common legal, Yes=1	234,570	0.362	0.481	0	1
Common religion, Yes=1	234,570	0.188	0.259	0	0.994
Common language, Yes=1	234,570	0.120	0.236	0	1
Ln Distance	234,570	8.703	0.827	2.134	9.886
			Panel B: 2014		
Exp>0, Yes=1	25,600	0.715	0.451	0	1
Export, bln USD	18,315	4.131	140.988	0	15319
Ln(1+Applied tariff/100)	14,704	0.081	0.065	0	2.206
FTA, Yes=1	25,600	0.168	0.374	0	1
Common border, Yes=1	25,600	0.025	0.157	0	1
External trade, Yes=1	25,600	0.994	0.079	0	1
Colonial past, Yes=1	25,600	0.013	0.113	0	1
Common legal, Yes=1	25,600	0.332	0.471	0	1
Common religion, Yes=1	25,600	0.182	0.258	0	0.994
Common language, Yes=1	25,600	0.113	0.227	0	1
Ln Distance	25,600	8.672	0.832	2.134	9.886

(ii) BRI trade cost reductions

We use the Global Dataset from the Belt And Road Initiative Trade Costs Database that provides estimates of the trade cost reductions associated with the BRI (De Soyres et al., 2018).[13] These estimates are compared against the uniform trade cost reductions of 5, 10, 15 and 20 percent and the results are presented in the next section.

[13] We would like to thank Michele Ruta for sharing the dataset with us. The data is available at https://datacatalog.worldbank.org/dataset/belt-and-road-initiative-trade-costs-database

V. Empirical Results

Estimating FTA and tariff elasticities

Rather than relying on just the 2014 sample, we use all available data to estimate FTA and tariff elasticities. Table 3 presents the estimations of export elasticities with respect to trade policy variables. We utilize PPML and fixed effect methods, both of which are common in the literature (Head & Mayer, 2014). The sample of 157 countries in 2014 is used for the estimation of models (1) and (5), and a panel in 1960-2014 with 5-year intervals (4-year interval for the last time period) is used for the estimation of models (2)-(4) and (6)-(8). In all regressions, the standard errors are clustered at the country-pair level. We estimate the model without intra-national trade (columns 1-4) and with intra-national trade (columns 5-8) as the estimates may differ substantially (Bergstrand et al., 2015).

Table 3: Estimation of trade elasticities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Method	PPML	PPML	PPML	FE	PPML	PPML	PPML	FE
	No internal trade				**Internal trade included**			
Dependent variable	Exp_{ij}	Exp_{ij}	$Exp_{ij,t}$	$\ln Exp_{ij,t}$	$Exp_{ij,t}$	$Exp_{ij,t}$		$\ln Exp_{ij,t}$
FTA	0.464**	0.526**	0.160**	0.342**	0.464**	0.434**	0.440**	0.346**
	(0.063)	(0.056)	(0.026)	(0.030)	(0.063)	(0.048)	(0.044)	(0.030)
$\ln Dist_{ij}$	-0.808**	-0.771**			-0.808**	-0.775**		
	(0.044)	(0.040)			(0.044)	(0.034)		
Common border	0.391**	0.420**			0.391**	0.396**		
	(0.077)	(0.065)			(0.077)	(0.070)		
External trade						-2.821**		
						(0.080)		
Colonial past	0.146	0.090			0.146	0.157*		
	(0.096)	(0.093)			(0.096)	(0.068)		
Common legal	0.155**	0.204**			0.155**	-0.042		

	(0.049)	(0.044)			(0.049)	(0.049)		
Common religion	-0.185	-0.138			-0.185	0.545**		
	(0.120)	(0.095)			(0.120)	(0.100)		
Common language	0.128	0.112			0.128	0.398**		
	(0.144)	(0.125)			(0.144)	(0.102)		
Fixed effects:								
Exporter-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair	No	No	Yes	Yes	No	No	Yes	Yes
Sample	2014	1960-2014	1960-2014	1960-2014	2014	1960-2014	1960-2014	1960-2014
Observations	24492	223122	184508	117698	24492	224440	185826	119017
R^2				0.877				0.883

** Significant at the 1% level. * Significant at 5% level.

Notes: The estimation sample is DOTS IMF, for 157 countries. The time frame is 2014 for models (1) and (5), 1960-2014 with 5-year intervals (4-year interval for the last time period) for models (2)-(4) and (6)-(8). In all regressions, the standard errors presented in brackets are clustered at country-pair level.

This model is estimated using the STATA **reghdfe** command with the natural log of export as the dependent variable and a full set of bilateral, exporter-time, and importer-time fixed effects (Correia, 2017). We use the sample in 1960-2014 that includes intra-national trade flows. The estimates of the FTA coefficient are quite consistent and robustly stay the 0.16-0.53 range. For most scenarios, we take the FTA coefficient value of 0.35 from model (8) as our baseline FTA parameter, which implies that countries with FTAs trade 42 percent more than those without. Similar model specifications estimated by PPML (column (7) using STATA command **ppmlhdfe** (Correia et al., 2019) results in an FTA coefficient of 0.44, which implies 55 percent higher trade between countries with an FTA. In our FTA scenario, we consider the range 0.15-0.45 of FTA coefficients to check the sensitivity of our results to the change in the FTA assumption.

To estimate the welfare changes due to the tariffs, we estimate the trade elasticity of tariffs, as presented in Table 4. We estimate tariff elasticities separately because Effectively Applied tariffs vary over time and differ across country-pairs due to existence of preferential rates and differences in composition of products at 10 digit product classification (see TRAINS). We report the FE and PPML estimates with a full set of fixed effects for 2014 and 1990-2014 samples. All standard errors are clustered at the country-pair level. In the counterfactual scenarios we use the coefficient from model (3), but in Table C1 in the appendix we also report the results with the coefficient from model (4).

Table 4: Elasticity of trade with respect to applied MFN tariff

	(1) PP ML 2014	(2) FE 2014	(3) PPML 1990-2014	(4) FE 1990-2014
Effectively Applied tariff	-3.074**	-0.90+	-2.458**	-0.409**
	(0.980)	(0.518)	(0.218)	(0.122)
Observations	15426	13461	59444	53813
R^2	0.972	0.773	0.987	0.931

** Significant at the 1% level. * Significant at 5% level. + significant at 10% level.

Notes: Estimation sample is DOTS IMF for 157 countries, internal trade included. The time period is 2014 for models (1) and (2), 1990-2014 with 5-year intervals (4-year interval for the last time period) for models (3) and (4). In all regressions, the standard errors presented in the brackets are clustered at the country-pair level. Other controls include exporter, importer, distance, common border, colonial past, common legal, common religion, common language, and FTA for models (1) and (2); exporter-year, importer-year, country-pair and FTA for models (3) and (4).

VI Welfare effects

Simulations: BRI and China-EU FTA, Scenarios 1-3

In this section we consider the first 3 scenarios of trade between China and the EU. The BRI scenario reduces transportation costs between China, BRI countries, and the EU by a certain percentage due to transport infrastructure projects that include building new high-speed railway connections, improving shipping routes, and investing in road infrastructure. In addition, we use the World Bank estimates of trade cost reductions from De Soyres et al. (2018) that are based on a Geographic Information System analysis of planned BRI projects to compare the results. We take their estimates of the upper-band of trade cost reductions in bilateral trade that include improvements in border time facilitation and present the simulation results in the column titled WB. We consider these two approaches as complementary, since the WB trade cost reduction estimates are focused on maritime projects and measure only the direct trade cost reductions, ignoring the trade cost reductions for goods in transit. According to our approach, investment in transport infrastructure in Kyrgyzstan, Kazakhstan and Russia have important implications for transport cost reductions for goods that are transported from China to the EU, since inland transport routes become cheaper and faster.

The EU FTA scenario considers the effects of signing an FTA between China and the EU. Finally, the BRI&EU FTA scenario considers the simultaneous implementation of transport cost reductions and signing the FTA. The last two scenarios serve three purposes. First, EU FTA is a benchmark against which to compare our BRI results. Second, BRI&EU FTA illustrates that the welfare gains of the combined policies suggest that gains from BRI&EU FTA exceed the sum of gains from BRI and EU FTA; in short, combining the two policies is super-additive. Third, it accounts for the potential trade policy facilitation between China and the EU that may accompany BRI implementation.

Table 6 presents the conditional (left panel) and full (right panel) GE welfare gains of these scenarios relative to the status quo in 2014 across different regions and for a range of the assumptions about the trade cost reductions.

To compute welfare gains we use $\sigma = 5.13$, which is consistent with the mean value for price elasticity in the structural gravity models (see Table 3.5 in Head and Mayer, 2015).

There are several important results. First, China and the EU countries both gain under all three scenarios, with significantly higher welfare increases in China than in the EU countries. This is partly due to China improving its trade access to both the BRI and EU countries and also because China's exports to the EU are double those of the EU to China – in 2014 the EU exported 183 bln USD of goods to China, while China exported 371 bln USD of goods to the EU. Other countries in Europe and Central Asia also benefit from the BRI because most of the countries in the region are involved in BRI projects, with Central Asia playing a key role in the Eurasian transport corridor, and Eastern European countries benefiting from lower trade costs with China.

Full GE gains are higher than conditional GE gains for all regions and under all trade cost reduction assumptions. A reduction in trade costs leads directly to welfare improvements, but also allows producers to increase `factory gate' prices without having to experience a negative impact on demand. As a result, producers gain income and increase their expenditure, leading to further welfare improvements. Most countries gain in both general and conditional GE scenarios. The only countries that are influenced negatively are the closest trading partners of China – Japan, Korea, and Vietnam, and this can be explained by the increased competition from the EU and BRI countries that leads to trade diversion. However, under the full GE, the negative impact disappears due to the indirect positive effect on income and expenditure in China, BRI countries, and the EU.

Comparing welfare gains from the uniform trade cost reductions with the welfare gains from the trade cost reductions estimated by the World Bank, it is clear that the WB estimates predict higher benefits for the countries in Europe, Central Asia and South Asia. At the same time, benefits for China and the EU are consistent with 10-15% of the uniform trade cost reductions.

Second, assuming an FTA coefficient of 0.35, signing and implementing an FTA between China and the EU would generate a 1.25 percent welfare improvement in the EU and 2.52 percent increase in China under the full GE scenario. To put it into perspective, this increase can also be achieved by transport cost reductions of approximately 15-20%. The liberalization of trade with the EU would have a negative partial equilibrium impact on welfare for the closest neighbors of China in the East Asia and Pacific region, such as Japan, Korea, and Vietnam. Interestingly, unlike the BRI scenarios, European and Central Asian countries are not predicted to benefit as much from a China-EU FTA as are the more remote countries in the Americas and Middle East. A China-EU FTA would generate considerable trade diversion, causing negative impact for China's closest neighbors and the non-participatory countries in Eurasia. However, under the full GE the impact of an FTA is positive in all regions.

Third, a combination of a reduction of transportation costs with signing an FTA generates welfare gains that exceed the sum of the welfare gains from the separate implementation of these two policies. This indicates that the policies complement and reinforce each other – an FTA boosts trade disproportionally more for countries that also reduce transportation costs. The only region that loses as a result of the BRI is East Asia and the Pacific. However, the losses are small, and the overall effect on the global economy is positive. Moreover, under the full GE all regions gain from the BRI&EU FTA.

In order to understand how the BRI project influences different income categories, Table 7 reports welfare gains by income group, as defined by the World Bank classification. It suggests that in all three scenarios, countries in all income groups gain, but the lower middle-income countries gain relatively more than the other groups. Also, high income and upper-middle income countries gain relatively more than low income countries. Assuming 15 percent transport cost reductions and the conditional GE result, high-income countries increase their welfare by 0.34 percent under the BRI scenario and by 0.86 percent under the BRI&EU FTA scenario. The upper middle-income countries receive similar welfare gains. This result is not surprising since the EU countries that would benefit from the BRI and China-EU FTA are mostly high-income countries, while China and many BRI countries (Belarus, Kazakhstan, Russia) are upper middle-income countries. At the same time, implementing the BRI scenario would increase welfare in low-income countries by 0.21 percent, while the combination of the BRI&EU FTA would boost welfare in these countries by 0.35 percent. The gains come as a secondary effect of lower transportation costs on the multilateral resistance terms. The WB estimates of the trade cost reduction, however, predict that low income countries gain more than high and upper middle income, which is due to the fact that there are many projects related to the BRI in low income countries.

Table 6: Welfare gains of BRI, EU FTA, and BRI&EU FTA by regions

A. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) by region, %

Region	**CGE, Reduction in transport costs, %**	**Full GE, Reduction in transport costs, %**

	5	10	15	20	WB	5	10	15	20	WB
China	0.65	1.34	2.09	2.90	1.13	0.75	1.57	2.45	3.43	1.20
East Asia & Pacific	0.13	0.26	0.41	0.56	0.71	0.23	0.48	0.74	1.03	0.48
Europe & Central Asia	0.16	0.33	0.50	0.69	1.91	0.26	0.54	0.84	1.17	1.92
European Union	0.13	0.27	0.42	0.58	0.44	0.23	0.49	0.76	1.05	0.88
Latin America & Caribbean	0.07	0.14	0.21	0.29	0.09	0.17	0.35	0.54	0.75	0.41
Middle East & North Africa	0.13	0.27	0.42	0.57	0.78	0.23	0.48	0.75	1.04	0.99
North America	0.06	0.13	0.19	0.27	0.51	0.16	0.34	0.52	0.73	0.69
South Asia	0.23	0.47	0.73	1.01	2.08	0.33	0.69	1.07	1.49	2.63
Sub-Saharan Africa	0.05	0.10	0.16	0.22	0.30	0.15	0.31	0.49	0.68	0.69
All	0.11	0.22	0.35	0.48	0.65	0.21	0.44	0.68	0.95	0.91

B. Mean welfare gains of signing FTA EU and China by region, %

Region	**CGE, FTA coefficient**				**Full GE, FTA coefficient**			
	0.15	**0.25**	**0.35**	**0.45**	**0.15**	**0.25**	**0.35**	**0.45**
China	0.81	1.42	2.09	2.82	0.99	1.72	2.52	3.40
East Asia & Pacific	-0.07	-0.11	-0.13	-0.13	0.09	0.17	0.26	0.38
Europe & Central Asia	0.02	0.05	0.11	0.20	0.18	0.33	0.51	0.72
European Union	0.32	0.56	0.84	1.14	0.49	0.85	1.25	1.69
Latin America & Caribbean	0.07	0.14	0.22	0.34	0.23	0.42	0.62	0.86
Middle East & North Africa	0.05	0.11	0.20	0.31	0.22	0.39	0.59	0.82
North America	0.06	0.12	0.21	0.32	0.22	0.40	0.60	0.84
South Asia	-0.06	-0.08	-0.08	-0.07	0.10	0.20	0.31	0.44
Sub-Saharan Africa	0.05	0.10	0.17	0.26	0.21	0.38	0.57	0.78
All	0.09	0.17	0.27	0.40	0.25	0.45	0.67	0.92

C. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) and signing FTA EU and China by region, %

Region	**CGE, Reduction in transport costs, %**					**Full GE, Reduction in transport costs, %**				
	5	**10**	**15**	**20**	**WB**	**5**	**10**	**15**	**20**	**WB**
China	2.78	3.52	4.32	5.19	3.23	3.36	4.26	5.25	6.34	3.94
East Asia & Pacific	-0.01	0.12	0.25	0.39	0.6	0.5	0.75	1.02	1.31	0.8
Europe & Central Asia	0.26	0.42	0.59	0.77	2.03	0.78	1.06	1.37	1.71	2.48
European Union	0.98	1.12	1.28	1.45	1.27	1.51	1.79	2.09	2.42	2.2
Latin America & Caribbean	0.29	0.36	0.44	0.51	0.32	0.81	1	1.21	1.45	1.12
Middle East & North Africa	0.32	0.45	0.59	0.74	0.96	0.84	1.1	1.38	1.68	1.71
North America	0.27	0.33	0.4	0.47	0.71	0.78	0.97	1.18	1.4	1.42
South Asia	0.13	0.36	0.59	0.85	1.98	0.64	1	1.38	1.79	2.98
Sub-Saharan Africa	0.22	0.27	0.33	0.39	0.47	0.73	0.91	1.1	1.31	1.4
All	0.38	0.49	0.61	0.74	0.92	0.89	1.13	1.39	1.68	1.67

Notes: This table presents welfare gains computed for the conditional (equation (15)) and full (equation (18)) GE. We assume 5-20% transport cost reductions between China and the EU, China and BRI countries (see appendix A). Alternatively, we also use De Soyres et al.'s (2018) trade cost reduction estimates labeled as WB. Elasticity of substitution is 5.13. FTA coefficient for Panel C is 0.35.

Table 7: Welfare gains by country income groups and non-BRI vs BRI countries

A. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) by group, %

Group	**CGE, Reduction in transport costs, %**					**Full GE, Reduction in transport costs, %**				
	5	**10**	**15**	**20**	**WB**	**5**	**10**	**15**	**20**	**WB**
High income	0.11	0.22	0.34	0.47	0.49	0.21	0.43	0.67	0.94	0.7
Low income	0.07	0.13	0.21	0.29	0.69	0.17	0.35	0.54	0.75	1.09
Lower middle income	0.13	0.26	0.41	0.56	0.89	0.23	0.48	0.74	1.03	1.09
Upper middle income	0.12	0.24	0.38	0.52	0.59	0.22	0.46	0.71	0.99	0.88
Non-BRI	0.07	0.14	0.21	0.3	0.2	0.17	0.35	0.55	0.76	0.49
BRI	0.18	0.37	0.58	0.8	1.46	0.28	0.59	0.92	1.27	1.65

B. Mean welfare gains of signing FTA EU and China by group, %

Group	**CGE, FTA coefficient**				**Full GE, FTA coefficient**			
	0.15	**0.25**	**0.35**	**0.45**	**0.15**	**0.25**	**0.35**	**0.45**
High income	0.18	0.33	0.51	0.72	0.35	0.62	0.91	1.25
Low income	0.04	0.08	0.15	0.24	0.2	0.36	0.55	0.76
Lower middle income	0.01	0.03	0.07	0.14	0.17	0.31	0.47	0.65
Upper middle income	0.08	0.15	0.25	0.37	0.24	0.43	0.65	0.89
Non-BRI	0.1	0.19	0.3	0.43	0.26	0.47	0.7	0.96
BRI	0.06	0.13	0.21	0.32	0.23	0.41	0.61	0.84

C. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) and signing FTA EU and China by group, %

Group	**CGE, Reduction in transport costs, %**					**Full GE, Reduction in transport costs, %**				
	5	**10**	**15**	**20**	**WB**	**5**	**10**	**15**	**20**	**WB**
High income	0.62	0.74	0.86	0.99	1.00	1.14	1.39	1.65	1.94	1.67
Low income	0.21	0.28	0.35	0.43	0.84	0.73	0.92	1.13	1.36	1.76
Lower middle income	0.19	0.32	0.46	0.6	0.96	0.71	0.96	1.24	1.54	1.68
Upper middle income	0.36	0.49	0.62	0.76	0.84	0.88	1.13	1.4	1.7	1.62
Non-BRI	0.36	0.44	0.52	0.6	0.49	0.88	1.08	1.3	1.53	1.27
BRI	0.39	0.57	0.76	0.97	1.67	0.9	1.22	1.56	1.92	2.38

Notes: This table presents welfare gains computed for the conditional (equation (15)) and full (equation (18)) GE. Income groups are defined according to the World Bank classification of countries. We assume 5-20% transport cost reduction between China and the EU, China and BRI countries (see appendix A). Alternatively, we also use De Soyres et al.'s (2018) trade cost reduction estimates labeled as WB. Elasticity of substitution is 5.13. FTA coefficient for Panel C is 0.35.

The full GE results predict more equal gains across the different income categories since the effects work via changes in prices. This, in turn, impacts aggregate demand, which is distributed across countries more uniformly than production. The BRI scenario of a 15 percent reduction in transport costs increases welfare in the high-income countries by 0.67 percent and in the low-income countries by 0.54 percent. High-income countries also gain more benefit from jointly implementing the China-EU FTA and the BRI: 1.65 percent increase versus 1.13 percent increase for the low-income countries.

Simulations: BRI and China-US trade war, Scenarios 4 and 5

We also consider how the BRI interacts with the potential impact of the China-US trade war, which is modelled as a reciprocal increase in tariffs on bilateral trade between China and the US at the levels of 10 percent, 25 percent, or 40 percent. Our main interest is in whether the welfare losses due to the trade war can be compensated for by the BRI. Table 8 presents estimates of the welfare gains of (i) the trade war and (ii) the combined impact of the trade war and BRI scenario. The increase of tariffs between China and the US to 10 percent reduces welfare according to the conditional GE by 0.17 percent in China and 0.66 percent in the US, and in the full GE by 0.29 percent in China and 0.78 percent in the US. These small changes in welfare are explained by the fact that the average ad valorem MFN rate in China is 9.59 percent and in the US is 4.01 percent. The welfare losses escalate if tariffs are increased to 25 percent, leading to 1.41 percent losses for China and 2.1 percent losses for the US in the conditional GE scenario. A 40 percent reciprocal tariff would be more costly for China (-2.61 percent in full GE) than for the US (-2.35 percent in full GE), whereas the bigger loser of a 40 percent tariff in a conditional GE scenario would be China (2.37 percent for China and 3.22 percent for the US).

The effect of the trade war is negative globally, with the Middle East and Africa among the most affected, leading to an overall 0.61-0.63 percent loss in welfare under the 25 percent tariff in the full GE. At the same time, panel B of Table 8 demonstrates that a 20 percent trade cost reduction associated with the BRI compensates for the negative effect of the trade war in most regions save from North America (assuming a 25 percent tariff). The result is weaker under the WB trade cost reduction estimates. It predicts that China would have a slight negative effect even if the planned BRI projects are implemented.

Table 8: Effect of trade war and its interaction with transport cost reduction on welfare in China.

A. Mean welfare gains of increase in bilateral tariffs between China and US, %

Region	**CGE, Trade War tariff, %**			**Full GE, Trade War tariff, %**		
	10	**25**	**40**	**10**	**25**	**40**
China	-0.17	-1.41	-2.37	-0.29	-1.59	-2.61
East Asia & Pacific	0.02	-0.04	-0.09	-0.1	-0.36	-0.56
Europe & Central Asia	-0.06	-0.24	-0.39	-0.18	-0.53	-0.81
European Union	-0.1	-0.36	-0.56	-0.22	-0.61	-0.93
Latin America & Caribbean	-0.12	-0.26	-0.38	-0.24	-0.46	-0.66
Middle East & North Africa	-0.08	-0.27	-0.43	-0.2	-0.61	-0.93
North America	-0.36	-0.93	-1.38	-0.48	-0.86	-1.26
USA	-0.66	-2.1	-3.22	-0.78	-1.57	-2.35
South Asia	-0.02	-0.18	-0.31	-0.14	-0.43	-0.67
Sub-Saharan Africa	-0.09	-0.32	-0.5	-0.21	-0.63	-0.94
Total	-0.08	-0.28	-0.44	-0.21	-0.56	-0.83

B. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) and Trade War between China and US, %

Region	**CGE, Reduction in transport costs, %**					**Full GE, Reduction in transport costs, %**				
	5	**10**	**15**	**20**	**WB**	**5**	**10**	**15**	**20**	**WB**
China	-0.65	0.07	0.83	1.66	-0.27	-0.86	-0.05	0.83	1.79	-0.31
East Asia & Pacific	0.25	0.4	0.55	0.71	0.83	0.03	0.28	0.55	0.84	0.37
Europe & Central Asia	0	0.17	0.34	0.53	1.73	-0.22	0.05	0.34	0.66	1.44
European Union	-0.15	0.01	0.17	0.34	0.1	-0.37	-0.11	0.17	0.47	0.3
Latin America & Caribbean	-0.05	0.02	0.1	0.18	-0.03	-0.27	-0.09	0.1	0.3	0.05
Middle East & North Africa	-0.08	0.05	0.19	0.33	0.53	-0.3	-0.07	0.18	0.45	0.45

North America	-0.76	-0.67	-0.58	-0.48	-0.38	-0.97	-0.78	-0.58	-0.36	-0.05
USA	-1.86	-1.79	-1.71	-1.62	-1.45	-2.06	-1.89	-1.71	-1.51	-0.63
South Asia	0.3	0.55	0.82	1.11	2.09	0.07	0.43	0.82	1.24	2.34
Sub-Saharan Africa	-0.12	-0.06	0	0.07	0.14	-0.34	-0.18	0	0.19	0.2
All	-0.05	0.07	0.2	0.33	0.47	-0.27	-0.05	0.2	0.46	0.46

Notes: This table presents welfare gains computed for conditional (equation (15)) and full (equation (18)) GE. Elasticity with respect to tariff is assumed to be -2.5 (see appendix C for results with different assumptions about this elasticity). We assume 5-20% transport cost reductions between China and the EU, China and BRI countries (see appendix A). Alternatively, we also use De Soyres et al.'s (2018) trade cost reduction estimates labeled as WB. We model the trade war between China and US as a uniform reciprocal increase in tariffs to the levels of 10, 25, and 40%. Elasticity of substitution is 5.13. Tariff level in panel B is assumed 25%.

VII. Robustness

Heterogeneity of regional trade agreements

The effects of regional trade agreements on trade may differ with the degree of integration, economic size, similarity of countries, and factor composition. To account for the heterogeneity of the impact as documented in Baier et al. (2019), we estimate the following model:

$$X_{ij,t} = \exp\left(\sum_A \gamma_A RTA_{ij,t} + \sum_F \sum_A \gamma_{A,F} RTA_{ij,t} F_{ij,t} + \chi_{it} + \xi_{jt} + \psi_{ij}\right) + u_{ij,t} \tag{22}$$

where A is a set of different types of RTAs and F is a set of factors that influence gains from RTAs. We use the 2020 update of Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008), which identifies three types of regional trade agreements as indicated by the World Trade Organization (WTO): FTAs, customs unions (CUs), and partial scope agreements (PSAs). In the case of PSAs, they are not defined in the WTO Agreement, but understood to be covering limited products and only permitted for developing countries, while FTAs and CUs are defined in Article XXIV of the General Agreement on Tariffs and Trade 1994. There is also a fourth deeper type of arrangement involving services; economic integration agreements (EIAs), which are defined in Article V of the General Agreement on Services. Hence, when a trade agreement is notified to the WTO it will be categorized as either a FTA, CU, PSA, EIA, FTA & EIA, CU &EIA, PSA & EIA. We merge PSAs with FTAs into a single category FTA to make the analysis more tractable.

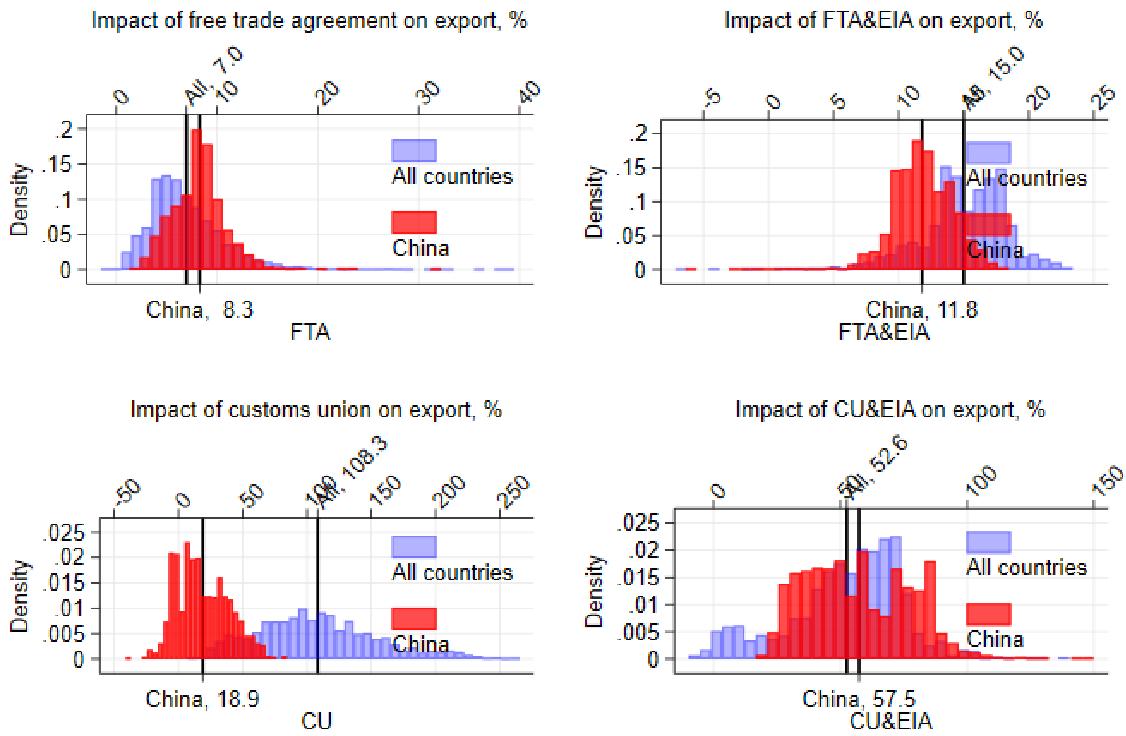
We distinguish four types of RTAs: FTA, FTA&EIA, CU, CU&EIA. In terms of factors, we consider economic size (log of sum of GDPs), similarity (log of absolute difference in GDP), and difference in factor endowment as factors (log of absolute difference in GDP per capita) that are relevant based on trade theory (Baier and Bergstrand, 2004).

We estimate (22) by PPML, the impact of regional trade agreements on trade, however, is dependent on the type of RTA and is also country-pair, time specific. To present results in a systematic way and to allow for comparisons across the types of RTAs, we compute expected export gains for an RTA of type A for country-pair *i* and *j* at time *t*

$$\Delta Exp^{A}_{ij,t} = 100\% \times \{\exp(\widehat{\gamma_A} + \textstyle\sum_F \widehat{\gamma_{A,F}} F_{ij,t}) - 1\} \qquad (23)$$

Figure 2 presents the distribution of export gains for two subsamples: for country-pairs that have an agreement of the corresponding type and for country-pairs where China is an exporter. FTAs generate positive export gains, but the effect is only a 7 percent increase in exports. In the case of China, the expected average effect of FTAs is 8.3 percent. Adding an EIA to an FTA agreement increases the impact on exports to 15 percent for all countries and to 11.8 percent for China. Forming a customs union doubles trade, but the effect for China is expected to be weaker and with high variance, with many negative numbers in the lower tail of the distribution. Finally, having a customs union with an EIA (the EU for example), has a strong positive effect on exports of 52 percent for all countries and 57.5 percent for China. It is worth mentioning here that the limited number of CUs, make it hard to disentangle idiosyncratic gains (i.e. MERCOSUR and EU) from general gains.

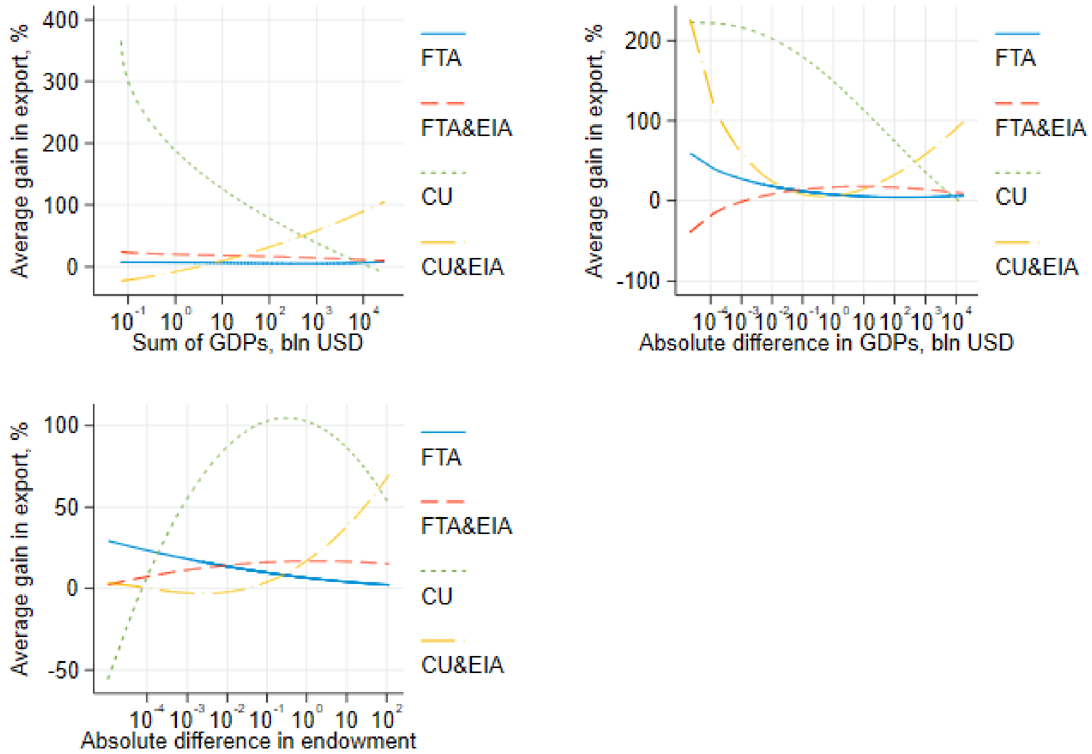
Figure 2: Export gains from different types of RTAs



This figure shows expected export gains from four different types of free trade and integration agreements for the whole sample and for the China sub-sample.

To understand how different factors contribute to export gains, Figure 3 presents graphs of gains in exports from RTAs against the three factors we introduced in our model. The impact of FTAs decline with economic size, differences in endowment, and differences in GDP.

Figure 3: Export gains and factors



This figure shows linear polinonial fit of the predicted gains against 3 factors

Table 10 presents the welfare gains of the China-EU trade agreement, which accounts for the heterogeneous effects of RTAs. In particular, the model predicts strong welfare gains from a CU&EIA type of agreement and from deeper FTA agreement, while a more shallow FTA would generate smaller gains. Comparing these results with the results in Panel B of Table 6, we see that FTAs generate welfare gains that are lower than the gains from the simulation model that assumes the coefficient of RTA of 0.15. At the same time, the strongest form of integration would generate effects that are stronger than in the simulation model that assumes the coefficient of RTA of 0.45.

Table 10: Welfare gains of different types of China-EU trade agreements

	CGE Type of FTA, mean welfare gains in %				Full GE Type of FTA, mean welfare gains in %			
Region	CU	CU&EIA	FTA	FTA&EIA	CU	CU&EIA	FTA	FTA&EIA
China	0.09	4.47	0.34	0.49	0.11	5.52	0.41	0.58
East Asia & Pacific	-0.01	-0.26	-0.02	-0.03	0.01	0.6	0.04	0.06
Europe & Central Asia	0.01	0.22	0.02	0.03	0.02	1.09	0.08	0.12
European Union	0.01	1.59	0.14	0.21	0.02	2.53	0.21	0.31
Latin America & Caribbean	0.01	0.46	0.04	0.06	0.03	1.34	0.1	0.15

Middle East & North Africa	0.01	0.41	0.03	0.05	0.03	1.29	0.1	0.14
North America	0.01	0.41	0.03	0.05	0.03	1.29	0.1	0.14
South Asia	-0.01	-0.24	-0.02	-0.03	0.01	0.62	0.05	0.07
Sub-Saharan Africa	0.01	0.35	0.03	0.04	0.02	1.23	0.1	0.14
All	0.01	0.53	0.05	0.07	0.02	1.41	0.11	0.16

While a CU&EIA would be attractive in terms of the potential welfare gains, this is not a realistic outcome of negotiations given the progress thus far. Generally, CUs are more complex and therefore much less common than FTAs. Therefore, a deep FTA is a more likely outcome and our results suggest that from the perspective of both China and the EU a shallow FTA is not worth pursuing. A deep FTA, which is what we modelled in the FTA scenario presented in our main results, is worthwhile.

Different values of elasticity of substitution

Welfare gains strongly depend on the elasticity of substitution parameter, σ. Our main table results are reported for $\sigma = 5.13$, as is common in the literature (see, for example, Head and Mayer, 2014). However, there are many studies that argue that the elasticity of substitution is much lower, in the 2.5-3 range (Boehm et al. 2020). Figures 4 and 5 present how welfare gains under the BRI&EU FTA scenario depend on the elasticity of substitution and the reduction in transportation costs between China, BRI countries, and the EU.

Figure 4: China welfare gains of BRI and EU FTA for different levels of trade cost reduction and different levels of elasticity of substitution

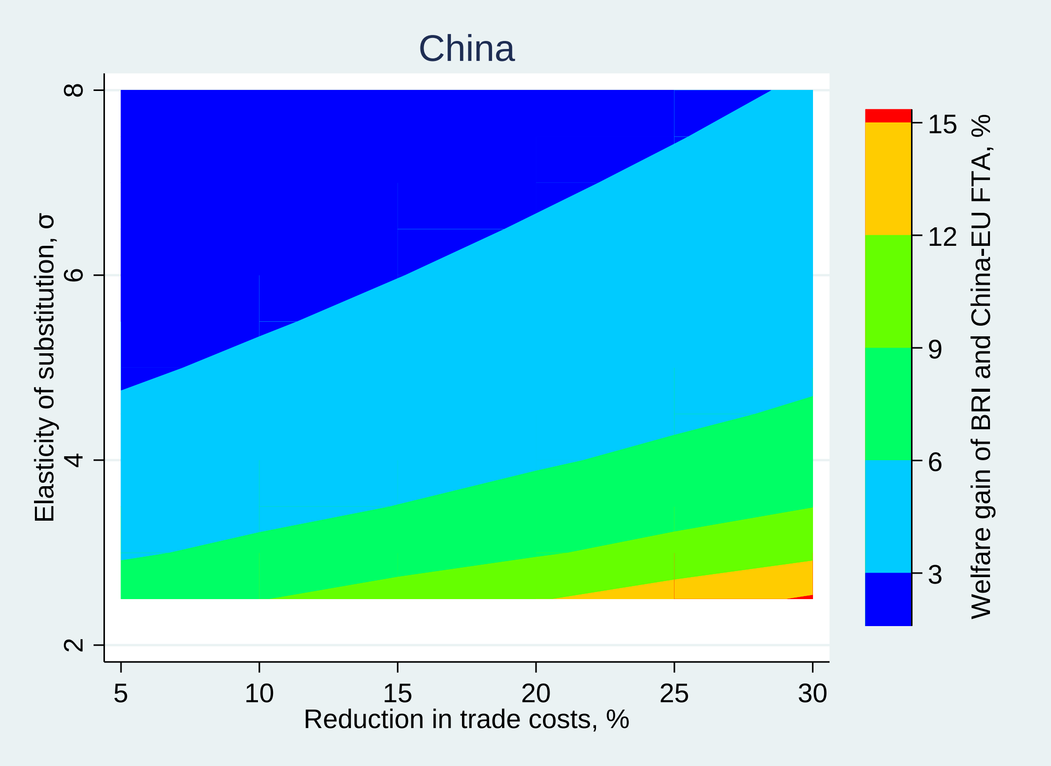
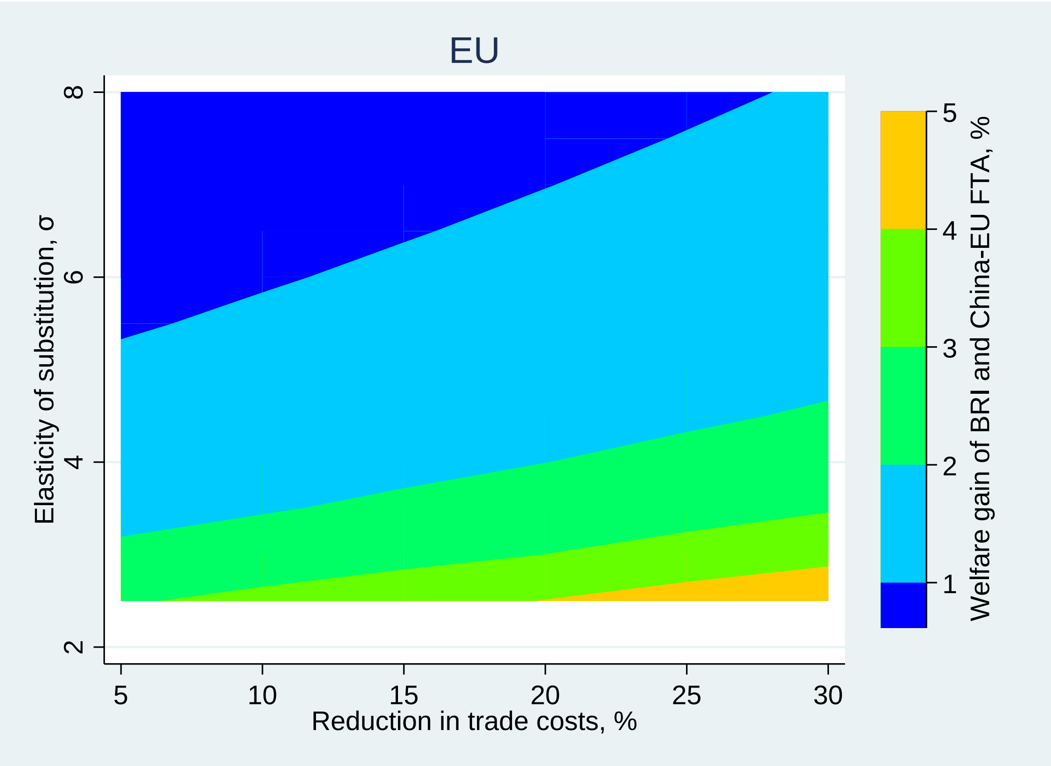


Figure 5: EU welfare gains of BRI and EU FTA for different levels of trade cost reduction and different levels of elasticity of substitution



A higher elasticity of substitution reduces welfare gains because consumers with a high elasticity of substitution are less concerned about consuming different varieties and more concerned about acquiring goods at the lowest price. This reduces incentives to trade similar goods while increasing incentives to trade based on comparative advantage. As expected, the highest gains are achieved when the elasticity of substitution is close to one, and transport costs between China and the EU are reduced by 50 percent. In that case, China gains more than 19 percent and the EU countries gain more than 10 percent.

VIII. Conclusion

The capital flows and transport cost reductions related to the BRI are fast becoming a reality. Our empirical findings justify China's massive financial commitment to the initiative, particularly in light of the uncertainty created by the China-US trade war. However, China may face problems regarding asset-quality risks that will further expose Chinese banks. The EU projects are less risky in comparison to the other steps that need to be taken on the BRI road. The EU can therefore capitalize on this opportunity if they can develop stronger strategic oversight of investment flows. However, China must avoid an escalation of the criticisms that have been levelled at their previous investments and must accustom themselves to working to timescales that allow for the appropriate due diligence. There is evidence of steps being taken to address a number of issues; for example, discussions about 'greening the belt' are gaining momentum and these may go some way to alleviating concerns that Chinese environmental issues are being offloaded via investments in polluting industries along the belt/road.

Moreover, our results also suggest that the rewards for both China and the EU can be even greater if they are also willing to commit to an FTA, this having been mooted as the potential next step now that the China-EU Comprehensive Investment Agreement has been agreed in principle. This gestalt approach requires policymakers to spell out the interconnectedness of the BRI, the China-EU Comprehensive Investment Agreement, and FTA initiatives, and this is only likely to happen if China is satisfied that the EU is a strong, stable, and credible partner. Further, China will need to make concessions that are unlikely to be possible in the short-term. The EU is wary of the balance of gains being weighed in China's favor; this imbalance is also highlighted in our empirical findings. The BRI countries are already seeking further detail on the initiative. In essence, the project needs to replace its vague slogans with some substance in the form of detail. China also needs to give at least the appearance of engaging with a level of plurilateral/multilateral dialogue. This may support a move from discrete projects to an infrastructure pipeline.

In conclusion, the BRI can play an important role in reducing, or potentially offsetting, the negative impact of the China-US trade war. At a time when recent elections and referendums have left the trading environment very uncertain, this initiative can offer China a way to counterbalance welfare losses from aggressive trade policy.

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Appendix A - Belt and Road Initiative, Key Countries

Lead	China
Southeast Asia (Group A)	Brunei Cambodia Indonesia Laos Malaysia Myanmar Philippines Singapore Thailand Timor-Leste Vietnam
South Asia (Group B)	Bangladesh Bhutan India Maldives Nepal Pakistan Sri Lanka
Central and Western Asia (Group C)	Afganistan Armenia Azerbaijan Georgia Iran Kazakhstan Kyrgyzstan Mongolia Tajikistan Turkmenistan Uzbekistan
Middle East and Africa (Group D)	Bahrain Egypt Iraq Israel Jordan Kenya Kuwait Lebanon

	Oman
	Palestine
	Qatar
	Saudi Arabia
	Syrian Arab Republic
	Tanzania
	Turkey
	United Arab Emirates
	Yemen
Central and Eastern Europe (Group E)	Albania
	Belarus
	Bosnia & Herzegovina
	Bulgaria
	Croatia
	Czech Republic
	Estonia
	Hungary
	Latvia
	Lithuania
	Macedonia
	Moldova
	Montenegro
	Poland
	Romania
	Russia
	Serbia
	Slovakia
	Slovenia
	Ukraine

Notes: 65 economies were listed in China's Official Action Plan for the BRI launched in March 2015 and six economies that have been associated with the initiative more recently, based on the World Bank report by Ruta et al., 2019. Some of the participating countries are not included in our analysis due to lack of data.

Appendix B – Planned projects by country and mode of transport

Figure B1: Seaports

Figure B2: Rail

Figure B3: Roads

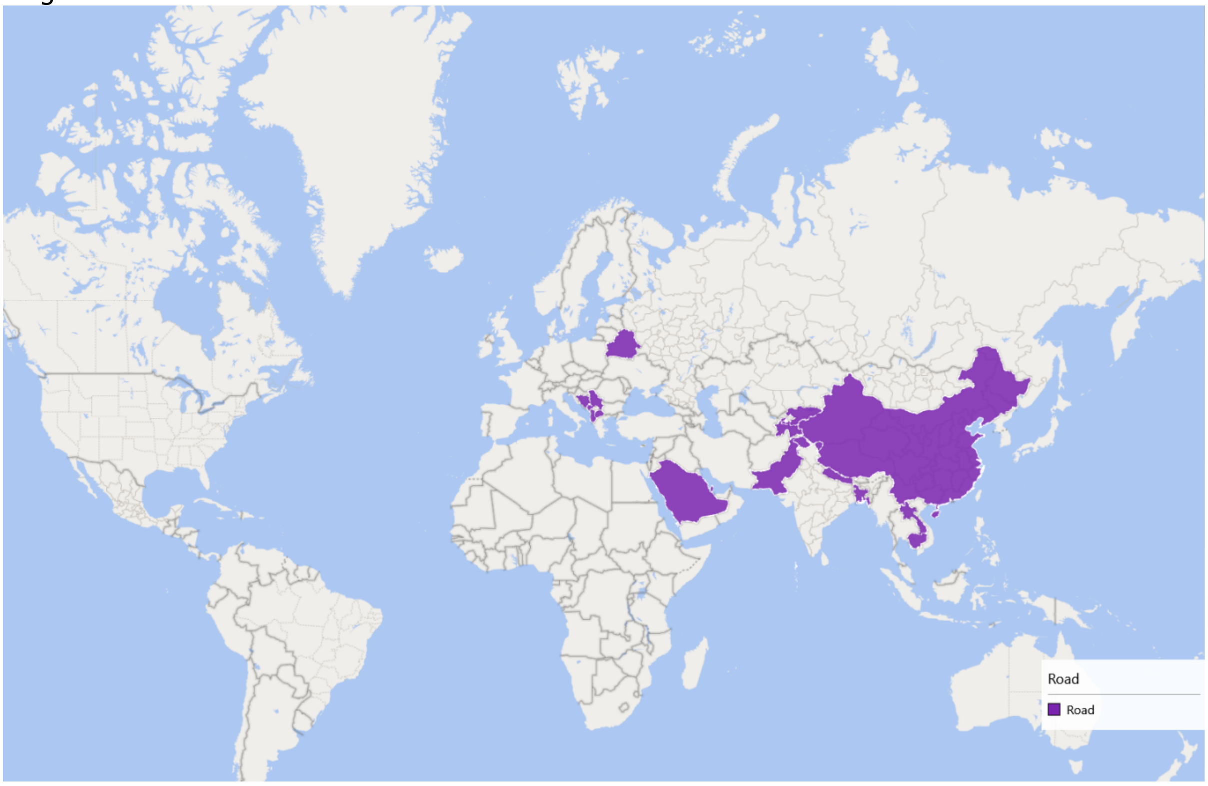

Figure B4: Intermodal

Source: Based on the Reconnecting Asia Project at the Centre for Strategic and International Studies

Appendix C - Different trade elasticities with respect to tariff

Table C1: Effect of trade war and its interaction with transport cost reduction on welfare in China.

A. Mean welfare gains of increase in bilateral tariffs between China and US, %

Region	**CGE, Trade War tariff, %**			**Full GE, Trade War tariff, %**		
	10	**25**	**40**	**10**	**25**	**40**
China	-0.03	-0.25	-0.47	-0.05	-0.32	-0.57
East Asia & Pacific	0	0	-0.01	-0.02	-0.07	-0.12
Europe & Central Asia	-0.01	-0.04	-0.07	-0.03	-0.11	-0.18
European Union	-0.02	-0.06	-0.1	-0.04	-0.12	-0.21
Latin America & Caribbean	-0.02	-0.04	-0.07	-0.04	-0.11	-0.18
Middle East & North Africa	-0.01	-0.05	-0.08	-0.03	-0.11	-0.19
North America	-0.06	-0.17	-0.27	-0.08	-0.23	-0.38
USA	-0.11	-0.38	-0.64	-0.13	-0.44	-0.74
South Asia	0	-0.03	-0.06	-0.02	-0.1	-0.17
Sub-Saharan Africa	-0.01	-0.05	-0.09	-0.04	-0.12	-0.2
Total	-0.01	-0.05	-0.08	-0.03	-0.11	-0.19

B. Mean welfare gains of reduction in transport cost due to One Belt One Road (BRI) and Trade War between China and US, %

Region	**CGE, Reduction in transport costs, %**	**Full GE, Reduction in transport costs, %**

	5	10	15	20	WB	5	10	15	20	WB
China	0.41	1.11	1.86	2.67	0.85	0.45	1.26	2.14	3.11	0.9
East Asia & Pacific	0.15	0.29	0.43	0.58	0.76	0.19	0.43	0.7	0.99	0.5
Europe & Central Asia	0.12	0.28	0.44	0.62	1.91	0.16	0.43	0.71	1.02	1.83
European Union	0.08	0.22	0.37	0.53	0.36	0.12	0.37	0.64	0.93	0.76
Latin America & Caribbean	0.04	0.1	0.17	0.24	0.08	0.08	0.25	0.44	0.64	0.36
Middle East & North Africa	0.08	0.19	0.32	0.45	0.72	0.12	0.34	0.59	0.85	0.89
North America	-0.09	-0.02	0.05	0.12	0.34	-0.05	0.12	0.31	0.52	0.54
USA	-0.32	-0.28	-0.24	-0.2	0.17	-0.28	-0.14	0.02	0.19	0.45
South Asia	0.24	0.48	0.74	1.02	2.08	0.28	0.63	1.01	1.43	2.58
Sub-Saharan Africa	0.02	0.07	0.12	0.18	0.29	0.06	0.21	0.39	0.57	0.6
All	0.08	0.19	0.3	0.43	0.63	0.11	0.33	0.57	0.82	0.83

Notes: This table presents welfare gains computed for conditional (equation (15)) and full (equation (18)) GE. Elasticity with respect to tariff is assumed to be -0.41. We assume 5-20% transport cost reductions between China and the EU, China and BRI countries (see appendix A). We also consider the trade war between China and US, as a uniform reciprocal increase in tariffs to the level of 10, 25, and 40%. Elasticity of substitution is 5.13. Tariff level in panel B is assumed 25%.